Request for Economic Stimulus Funds
STEM Concept Proposal

Submitters:
Science, Technology, Engineering & Mathematics (STEM) Education Workgroup
Dr. Lee Todd, Chair
Commissioner Deborah Clayton, Vice Chair

Project Title:
Kentucky's STEM Education Imperative

Project Partners/Team:
Kentucky Department of Education; Kentucky Council on Postsecondary Education; Cabinet for Economic Development; LexMark International, Inc.; Kentucky Chamber of Commerce; Kentucky Society of Professional Engineers; Girls' STEM Collaborative; Project Lead the Way; Kentucky Association of Manufacturers; business/industry and government sector partners.

Project Background & Purpose:

Kentucky faces a critical moment in which it can re-define for the long-term the way its children learn math and science and prepare themselves for careers in STEM disciplines:

- Kentucky leaders in education, government, and business have recognized and given voice to the Commonwealth's critical need for a workforce more deeply populated with mathematicians, scientists, and engineers.
- The Beshear Administration has worked diligently and effectively to make Kentucky competitive in the attraction and retention of high tech companies.
- Legislators from both parties in both chambers have invested considerable effort and substantial funding to elevate Kentucky's STEM efforts.
- The presidents of Kentucky's universities have expressed support for and a willingness to provide strengthened and continuing pre-service and in-service training to P-12 teachers in these areas of critical need.
- Superintendents and school boards across Kentucky have seen the need to dramatically improve the way teachers teach and students learn, especially in STEM-related curricular areas.
- Schools scattered throughout the state have made STEM education a priority and have leveraged available state resources to do the job; but, those accomplished efforts remain too isolated and episodic.
- Kentucky has the natural resources to be a leader in America's move toward energy independence; but the state's ability to seize the mantle of leadership is tied to strengthening the supply of STEM professionals.
- The recent announcement that Argonne National Laboratory will locate a research and development (R&D) Advanced Battery Technology Center in Kentucky gives momentum to the call for more STEM graduates/researchers.

- The National Alliance for Advance Transportation Batteries (NAATBatt) initiative's headquarters' move to the state strengthens the urgency of producing more STEM graduates.
- The aging of Kentucky's teaching force requires creative ways of re-engaging aging teachers and recruiting and keeping new ones, especially in STEM.
- The Obama Administration and the federal Stimulus Package have made a priority of funding innovative and proven approaches to P-12 education.

This is Kentucky's moment.

The creation of a skilled STEM workforce is the cornerstone for research and development, and consequently the key to innovation and success in the knowledge-based economy. There is broad agreement that STEM education in the United States is not producing the quality and quantity of graduates needed to make the U. S. competitive. Numerous analyses have documented that Kentucky ranks below the national average in developing scientific and innovation talent as reported in National Science Foundation's *Science and Engineering Indicators, 2008*. In 2007, the Council on Postsecondary Education's STEM Task Force (STEM I) identified a strong emphasis on P-20 collaborative partnerships with multi-sectors, including business, industry, and civic community leaders, as the mechanism to bridge the chasm between education and employer needs in the 21st Century. Specifically, STEM I identified a critical need for teaching a much more rigorous STEM curricula and teacher education focused on enhanced STEM disciplined and embedded pedagogy.

> *". . . these commitments of improvement in teacher effectiveness and ensuring all schools have highly qualified teachers; making progress toward college- and career-ready standards; improving achievement in low-performing schools; and evaluation of the above through enhanced data systems that track progress, will help ensure outstanding teachers in America's schools, arm educators with the tools and data needed to determine what does and doesn't work in our nation's classrooms, align curricula and assessments with rigorous standards that prepare young people for college and careers, and transform our lowest-performing schools."* Arne Duncan, U.S. Secretary of Education.

It is not enough to encourage and applaud isolated efforts in various schools in various parts of the state. Key to Kentucky's successful participation in the knowledge economy is for all Kentucky schools to be given the opportunity to embrace dramatic and lasting change and progress in the STEM education they provide, the knowledge to be effective, and the tools to do the job.

Kentucky needs to strengthen the STEM education of all middle and high school students to make them college and STEM career-ready; improve teacher effectiveness; and utilize rigorous assessments to monitor learning outcomes.

Scaling statewide rigorous STEM education curricula responds to President Obama's strong commitment to spur innovation in America's schools and his willingness to put Stimulus Package dollars to the task of supporting effective curricular models.

<u>Project Description</u>:

STEM I and subsequent workgroups have determined that *Project Lead the Way™ (PLTW),* when implemented statewide, will increase engineering, biomedical, manufacturing, and energy

talent pipelines in Kentucky and therefore deliver the quantity and quality of students graduating from high school prepared for high-tech fields. PLTW has been praised by numerous professional organizations, including the Aerospace Industry Association and the Society of Manufacturing Engineers, and was the subject of a recent segment on National Public Radio entitled, "Can Science Reasoning Be Taught?"

PLTW (http://www.pltw.org/index.cfm) is a nationally-recognized middle and high school curriculum focused on project and problem-based contextual learning aimed at cultivating student interest in pursuing careers in engineering and engineering technology. PLTW currently focuses on the development of STEM skills preparing students for pre-engineering, bio-medical, and energy-related postsecondary education. The success of PLTW depends on partnerships involving middle and high schools, colleges and universities, and the business and government sectors. Kentucky already has invested seed money in PLTW. The 2006 and 2008 Kentucky General Assembly appropriated funds to begin implementing PLTW in Kentucky. To date, nearly 100 schools have registered to participate, but only 60 schools have implemented the program, with nine schools' proposals approved to begin in 2009-2010. These participating schools represent only 15 percent of Kentucky's 174 public school systems. There are 224 middle schools and 225 high schools statewide. National and Kentucky data show PLTW is a program that works as shown in Appendix I. PLTW students have higher standardized test scores, they are much more likely to complete four years of math and science during high school, their college preparation is better, and 97 percent of them plan to attend college, with 80 percent indicating their primary area of study will be engineering, technology or computer science. Clear evaluative measures are in place to monitor outcomes and track student progress through Kentucky's educational data portal, as well as national PLTW metrics. There are several reasons PLTW is appealing to schools and teachers and effective for students:

> "*. . . since we know that the progress and prosperity of future generations will depend on what we do now to educate the next generation, today I am announcing a renewed commitment to education in mathematics and science. Think about new and creative ways to engage young people in science and engineering, . . . encourage young people to create, build, and invent to be makers of things, not just consumers of things*. Barack Obama, U.S. President.

- PLTW provides an equal opportunity for all students regardless of prior learning.
- Implementation is straight-forward with few changes to existing curriculum, enriching core content.
- Extensive and continuous professional development for teachers is required and provided via an established Kentucky university affiliate that partners with regional comprehensive and community/technical postsecondary institutions.
- Teacher training takes place through summer institutes and "virtual academies," offering graduate education credit for professional development.
- Equipment/software installation and maintenance are available to all participating systems.
- Partnering with local employers and mentors from diverse sectors of society is an eligibility criteria for participation, to best serve an integrated knowledge-based economy.
- PLTW courses are considered part of the general education courses in the regular high school program, reflecting national standards in math, science, and technology.

PLTW also is aligned with Kentucky's other continuing efforts in STEM education, including the Girls' STEM Collaborative, AdvanceKentucky, the Partnership Enhancement Projects (PEP), the Center of Integrative Natural Science and Math (CINSAM), and SKYTeach.

PLTW is cost-prohibitive for many schools in Kentucky due to the added teacher load (teacher to student ration of 1:20), additional laboratory space, furniture, computer equipment, and software. The program is high tech and high touch, demanding continuous upgrades. Many Kentucky school systems do not have capacity to provide substitutes or the cost of Summer Institutes for teachers' professional development, which is intense requiring annual continuing education. Without financial assistance many school systems would not be able to provide PLTW independent of the commitment of additional state, community, and multiple sector support.

PLTW can be expanded and further developed in Kentucky with a systematic investment in human capital and equipment. Already in place is the technical advisory expertise of the Kentucky Department of Education. Clearly, state level financial support has been critical to school implementation as illustrated by the Kentucky General Assembly's investments made through KDE energy initiatives, and CPE's pre-engineering pipeline funds. This proposal provides annualized investments needed for statewide scaling of STEM education.

In addition to strengthening schools for the long-term, PLTW P-12 opportunities will subsidize technical support in each of the 130 schools, equipping laboratories with new, high tech and scientific equipment. In addition, rigorous STEM professional development for over 390 teachers and counselors will be provided.

Project Budget and Amount of Economic Stimulus Funds Requested:

Expanding PLTW to 130 additional Kentucky middle and high schools in two years will cost an estimated $13.5 million. This includes professional development funds and equipment start-up costs. Clear support has been demonstrated by the Kentucky Department of Education, the Council on Postsecondary Education, Cabinet for Economic Development's Department for Commercialization and Innovation, LexMark International, Inc., Kentucky Society of Professional Engineers, business and industry leaders, public/private sector interests, and both parties in both chambers of the Kentucky General Assembly. Kentucky has invested to date $2.8 million in PLTW, in addition to KDE, CPE, the University of Kentucky and local investments.

The General Assembly created a second STEM Task Force (STEM II) and charged it with developing a business plan. That plan included the scaling of PLTW statewide. (http://cpe.ky.gov/NR/rdonlyres/9A310C72-2566-4BD3-9F55-F56608816C71/0/STEM2Report1208.pdf) This 2008 plan forged a phased approach to build strong collaborative sustaining new programs for two years, adding additional programs each year as schools become self-sustained by their systems. Funding opportunities through the federal Stimulus Package (American Recovery and Reinvestment Act – ARRA), National Science Foundation (NSF), U.S. Department of Education (DOE), as well as legislative support is needed to secure any and all funds to both scale and sustain the program. Additional funding opportunities through grants and foundations, as well as additional federal programs continue to loom on the horizon and aggressive efforts will continue to enhance all potential funding assistance.

Project Team:

Kentucky Department of Education, Office of Career and Technical Education, PLTW Director, Henry Lacy and Division Director, Deborah Anderson; Kentucky Community and Technical College System, pre-engineering/bio-science faculty; University of Kentucky PLTW National Affiliate Director, Diane Leveridge and College of Engineering; Eastern Kentucky University and Morehead State University pre-service teacher education programs.

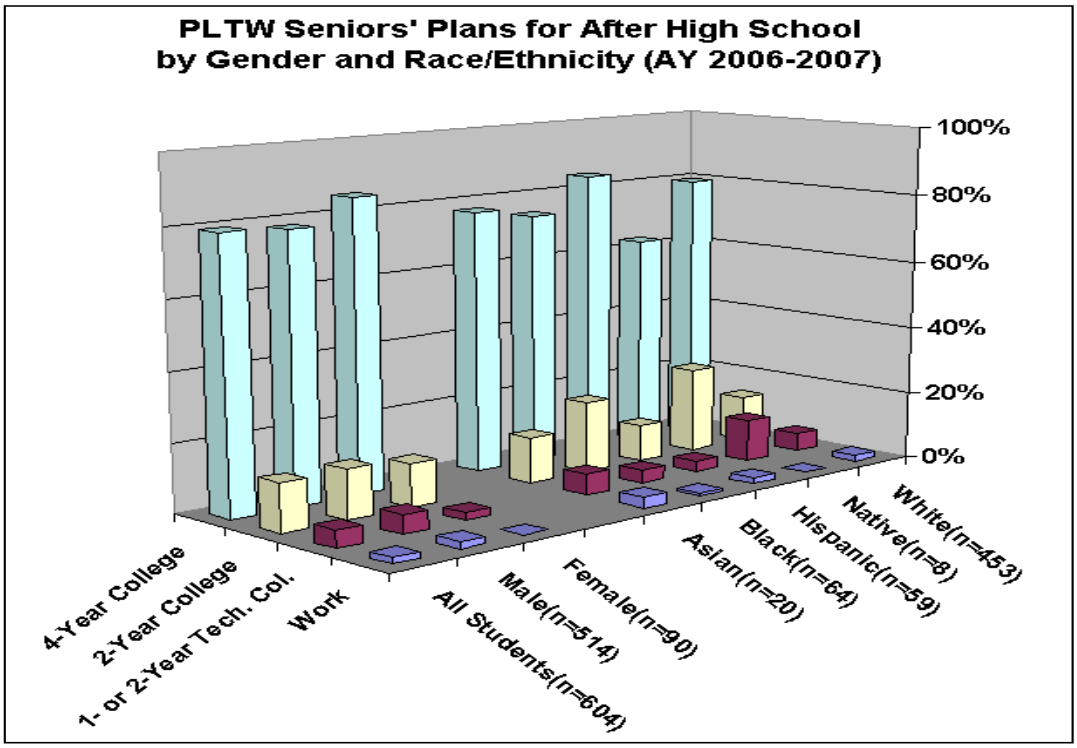
Two-year Stimulus Package Budget Proposal: (Appendix II.)

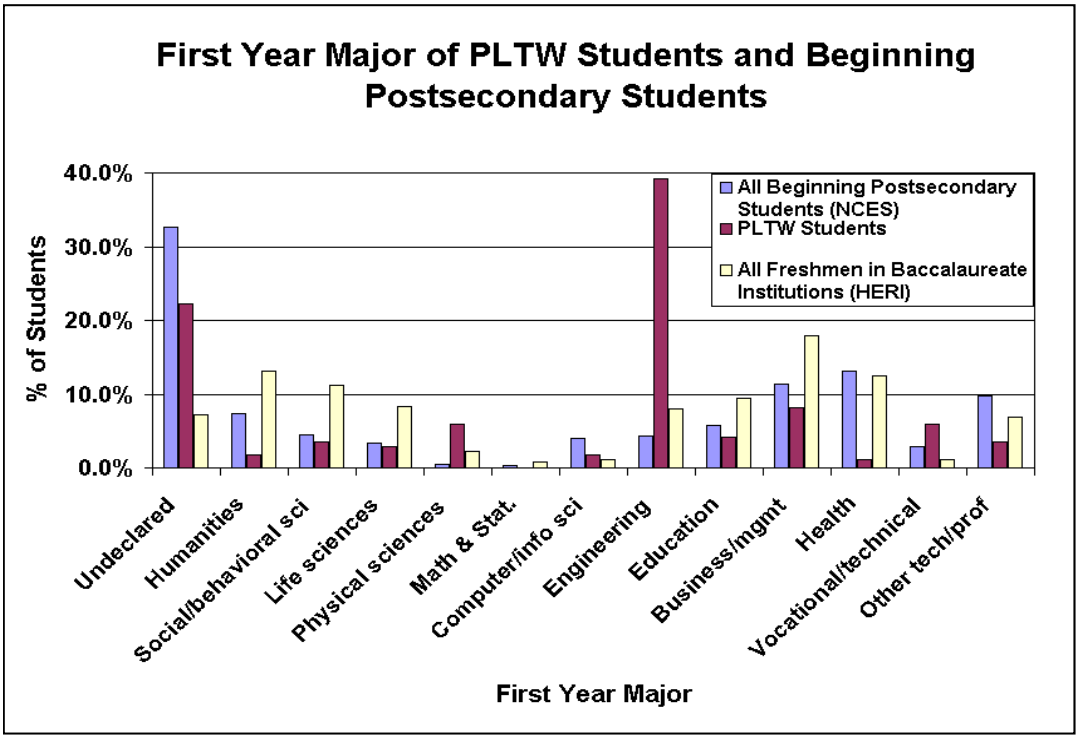
To scale the program rapidly utilizing national stimulus funds would enable PLTW to be provided in 199, or44 percent of Kentucky public middle and high schools within two years. Joint program proposals from smaller school systems should be rewarded for being fiscally responsive and best utilizing limited business/industry resources at the local level. Larger school systems with existing PLTW programs could serve as mentors and consultants to neighboring schools just beginning this process. School systems and administrators are willing to provide some start up funds and are required by national affiliation with PLTW to match costs of professional development for teachers and counselors.

The budget below reflects a quick start to scale 44 percent of Kentucky's middle and high schools with PLTW funding within the next two years. Beginning with 50 new programs in middle and high school pre-engineering/energy curricula and 30 new high school programs in the BioScience curricula, this stimulus proposal will fit the stimulus package objectives for immediate and long-term benefits. The program has clear evaluation metrics to ensure that it meets the stimulus package's strict transparency and accountability requirements.

A stimulus of funding to further development of PLTW in those schools that wish to register and provide system support for the initiative is estimated to be 80 percent. Scaling more quickly will shorten the time to 2020 goals and respond to a dire need expressed by state and national economic development goals of Kentucky.

Appendix I.


PLTW Seniors' Plans for After High School
by Gender and Race/Ethnicity (AY 2006-2007)
100%
80%
60%
40%
20%
0%
4-Year College
2-Year College
1- or 2-Year Tech. Col.
Work
All Students(n=604)
Male(n=514)
Female(n=90)
Asian(n=20)
Black(n=64)
Hispanic(n=59)
Native(n=8)
White(n=453)


First Year Major of PLTW Students and Beginning
Postsecondary Students
40.0%
30.0%
20.0%
10.0%
0.0%
% of Students
All Beginning Postsecondary Students (NCES)
PLTW Students
All Freshmen in Baccalaureate Institutions (HERI)
Undeclared
Humanities
Social/behavioral sci
Life sciences
Physical sciences
Math & Stat.
Computer/info sci
Engineering
Education
Business/mgmt
Health
Vocational/technical
Other tech/prof
First Year Major

Appendix II.

SCHOOL COST PROJECTIONS	Two Year Costs for Initiating 130 new PLTW schools		
	# Schools	Cost/Per School	Total 2-year Costs
Middle Schools (Pre-Eng/Energy)	50	$ 55,000	$ 2,750,000
High School (Pre-Eng/Energy)	50	$ 110,000	$ 5,500,000
High Schools (BioScience)	30	$ 100,000	$ 3,000,000
KDE Coordinators/Evaluators/Fiscal Management			$ 860,000
Technical Support (1 PT/school)	130	$ 5,000	$ 650,000
UK Affiliate, Institute Staff/Materials			$ 750,000
Annual Costs			**$ 13,510,000**

Budget Justification:

- PLTW is proposed for 130 new schools in Kentucky representing 29 percent of Kentucky middle and high schools. With the 69 schools with PLTW already, this will increase the number to 199, or 44 percent of schools providing pre-engineering/energy and/or bioscience STEM education.
- With 130 new programs being initiated within two years, the current KDE staff and training of teacher programs will be extremely taxed, so additional coordination at the state level with regional postsecondary institutions assisting with administration and training will be necessary.
- It is important that technical support/maintenance be provided to each new school which the districts may provide in-house or make provision for local technical support business to provide.

Results:

- Middle Schools with Pre-Engineering/Energy PLTW 50
- High Schools with Pre-Engineering/Energy PLTW 50
- High Schools with BioScience PLTW 30
- MS/HS Prior to 2010 School Year 60
- MS/HS New Pre-Engineering/Energy PLTW Schools 2009-2010 9
- Total Kentucky MS/HS with PLTW (44%) **199**